

REMARKS

Claims 13-24 are pending in this application. This Amendment amends claims 13, 19, 20, and 22. Claim 13 was amended to further define the mixture. Claim 19 was amended to address an indefiniteness rejection. Claim 20 was placed in independent form. Claim 22 was amended to correct a typographical error in part (c). Support for the amendments to claims 19, 20, and 22 may be found in the specification and drawings as originally filed.

35 U.S.C. §112 Rejections:

Claim 19 stands rejected under 35 U.S.C. §112, second paragraph, for indefiniteness. The Examiner states that it is unclear as to how the diameter of the droplets structurally limits the claimed device. The Applicants have amended Claim 19 to further define that 50% of the droplets in the separated parts of the mixture have an average diameter of $4\mu\text{m}$ or less. This indicates that the droplet size in the outlet openings has a relatively small value, which in turn is an indication of the separation efficiency of the cyclone. Reconsideration of the rejection of claim 19 is respectfully requested.

35 U.S.C. §102 Rejections:

Claims 13 and 15-19 stand rejected under 35 U.S.C. §102(b) as being anticipated by WO 97/49477 (hereinafter "the '477 reference"). Applicants respectfully traverse this rejection.

The present invention is directed to a device for treating a gas/liquid mixture. As set forth in independent claim 13, the device includes a tube having an inlet opening for the mixture and an outlet opening (12) for the mixture located downstream. A rotating means (13) is arranged in the tube for setting the mixture into rotating movement. One or more outlet openings are arranged downstream relative to the rotating means for allowing a separated part of the mixture to flow laterally out of the tube. A return or recycle conduit

(16) is arranged centrally in an axial direction through the rotating means (13) for reintroducing the flow which has exited via the outlet openings. A divergence means is arranged close to the outer end of the recycle conduit (16) for allowing the reintroduced flow to diverge laterally outward.

The '477 reference discloses a device for treating a gas/liquid mixture. The device includes an inlet (A) for infeed of the mixture, a flow element (4), an outlet (8), one or more feedback lines (B,D), and anti-creep flow means (7). The flow element is placed in line with the inlet with one or more swirling members (5) that cause turbulence in the mixture. The outlet (8) is placed in line with the flow element (4) for outfeed of the gas flow, which has liquid at least partially removed from the gas flow. Additionally, one or more feedback lines (B,D) are connected onto a channel (6) arranged centrally in the flow element (4) for discharge as a separated liquid into a part of the gas flow. The device also includes anti-creep flow means (7) for preventing creep flow along the flow element (4).

Regarding independent claim 13, the '477 reference does not teach or suggest a divergence means arranged close to the outer end of a return conduit for allowing the reintroduced flow to diverge outward. In contrast, the '477 reference minimizes liquid creep along the outlet of a return conduit with a creep interrupter and a creep element (7, 17) extending some distance outward relative to the outlet opening of the channel (12). In independent claim 13, the divergence means includes openings so as to have the recycle flow reenter the tube in a divergent manner, and the recycle cyclone divergence means is arranged close to the outlet opening of the recycle conduit (16) for allowing the reintroduced flow, which is the flow recycled via the openings in the cylindrical wall (11), an interspace (15), and the recycle conduit (16), to reenter the recycle conduit (16).

Furthermore, the divergence means in independent claim 13 allows for the elimination or considerable reduction of an axial jet flow of gas particles, thereby diminishing

the effects of liquid creep. This in turn allows for an increase in separation efficiency of the cyclone, especially for small particles. The cyclone of the '477 reference, on the contrary, has a limited maximum output because the residual creep has a strong negative influence on the separation efficiency due to the axial jet flow coming from the return conduit. The axial jet flow coming from the return conduit in turn has a negative effect on the rotation of the mixture downstream of the swirl elements causing a relatively low separation efficiency of small particles. Thus, the divergence means set forth in independent claim 13 overcomes the deficiencies of the cited prior art by preventing liquid creep to the middle of the swirl element, and the liquid droplets coming from the recycle flow in a lateral outflow are entrained in the swirl flow and separated via the slots, thereby allowing for higher separation efficiency.

In view of the foregoing, the '477 reference does not teach or suggest a divergence means as set forth in independent claim 13 and is not anticipated by or obvious over the '477 reference. Reconsideration of the rejection of claim 13 is respectfully requested.

Claims 15-19 depend directly or indirectly from and add further limitations to independent claim 13, and are believed to be patentable for the reasons discussed hereinabove in connection with independent claim 13. Reconsideration of the rejections of claims 15-19 is respectfully requested.

35 U.S.C. §103 Rejections:

Claims 20 and 21 stand rejected under 35 U.S.C. §103(a) as being obvious from the teachings of the '477 reference.

Claim 20 has been placed in independent form including the subject matter of independent claim 13. The Applicants respectfully disagree with the Examiner's assertion that the liquid drain conduit or pipe (3) set forth in independent claim 20 is inherent in the

system of the '477 reference and described as "one or more feedback lines for discharge of the separated liquid...". The feedback lines of the '477 reference do not refer to a liquid drain conduit for the vessel, but rather to paths (see B and D in Fig. 1) of the direction the liquid flows after exiting the longitudinal slots (19) from the device to a secondary inlet (11) to the internal channel (6) in the flow element (4). Therefore, the "one or more feedback lines" are utilized to recycle the liquid particles through the device (i.e., outside the device and back through the recycle conduit) for better separation and not as a drain conduit (3) for draining liquid collected in the bottom of the vessel (1). Furthermore, and as discussed above, the subject matter of independent claim 13, which has been incorporated into independent claim 20, is not taught or suggested by the '477 reference. For the foregoing reasons, the Applicants respectfully request reconsideration of the rejection of independent claim 20.

Claim 21 depends from and adds further limitations to independent claim 20 and is believed to be patentable for the reasons discussed hereinabove in connection with independent claim 20. Applicants request reconsideration of the rejection of claim 21.

Claim 14 stands rejected under 35 U.S.C. §103(a) for obviousness from the teachings of the '477 reference in view of U.S. Patent No. 4,187,089 to Hodgson (hereinafter "the Hodgson patent").

The Hodgson patent is directed to a horizontal vapor-liquid separator with a baffle aligned with a pipe (38) and spaced apart from a beveled end (29) thereof by means of axially extending and circumferentially spaced rib members (46), which are secured between the pipe (38) and a baffle base (41). In use, the mixture is fed through the inlet and through a tubing providing helical motion to cause the liquid components of the mixture to be collected at the bottom of a chamber (14). The flow stream exits the pipe (38) and any residual liquid in the mixture is directed against a conical baffle (44). The baffle (44) reverses the generally

forward flow of the stream and any droplets impinging on the baffle (44) are coalesced and fall to the bottom of the chamber (14).

The Applicants respectfully disagree with the Examiner's assertion that the Hodgson patent discloses slots and a conical end cap at the end of a return conduit instead of the cone-shaped end of the return conduit disclosed by the '477 reference. The Hodgson patent does not teach vertical slots, but rather teaches the use of spaced rib members (46) for spacing the baffle (44) apart from the beveled end (29) and not for diverging the fluid mixture as set forth in claim 14. Additionally, the Hodgson patent does not teach recessed slots in a part of a return conduit for divergence means, as set forth in claim 14. Furthermore, claim 14 depends from independent claim 13. The Hodgson patent does not cure the deficiencies of the '477 reference discussed above in connection with independent claim 13 and does not render claim 14 obvious. For these reasons, the Applicants respectfully request reconsideration of the rejection of claim 14.

Claims 22-24 stand rejected under 35 U.S.C. §103(a) for obviousness from the teachings of the '477 reference in view of WO 93/05339 (hereinafter "the '339 reference").

The '339 reference is directed to a steam separator that utilizes blades (12) to rotate a mixture of steam and water causing the water to form a film on the inside of a tube (1). A plurality of perforations (8) is located on the tube wall to allow the water to escape. The main tube includes a cylindrical section (2), which merges at the top into a tapering or conical tube section (3). Additionally, an outlet tube (9) is mounted at the upper narrow end of the conical tube section (3).

In contrast to the Examiner's assertion, the '339 reference fails to teach or suggest a conically tapering outlet pipe (31) and fails to teach or suggest a concentric pipe (33) that protrudes upstream into the outlet. Furthermore, the '339 reference fails to cure the deficiencies of the '477 reference with respect to independent claim 13, and thus claim 22,

which depends from independent claim 13, is not obvious over the '477 reference taken alone or in combination with the '339 reference. For the foregoing reasons, the Applicants respectfully request reconsideration of the rejection of claim 22.

Claims 23 and 24 depend from and add further limitations to claim 22 and are believed to be patentable for the reasons discussed hereinabove in connection with claims 13 and 22. The Applicants request reconsideration of the rejections of claims 23 and 24.

CONCLUSION

In view of the foregoing, the Applicants believe that claims 13-24 are in condition for allowance. Reconsideration of the Examiner's rejections and allowance of claims 13-24 are respectfully requested.

Respectfully submitted,

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